Appendix E: LANL Report: *Thermal Ionization Mass Spectrometry Uranium Results for October 2007 RFETS Waters*

Thermal Ionization Mass Spectrometry Uranium Results for October 2007 RFETS Waters

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Experimental Approach

Seven water samples were received at LANL and processed for uranium TIMS measurements. Aliquots of the samples were spiked with a ^{233}U spike, equilibrated by fuming with perchloric acid, and then chemically processed using ion-exchange columns to isolate and purify a uranium fraction. The processed samples were loaded onto triple filaments for analysis by thermal ionization mass spectrometry using a VG Sector 54 mass spectrometer. A chemistry process blank was also run that contained negligible uranium. NIST U standard U960 was analyzed as a QA check of the instrument.

Results

The sample results are tabulated in Table 1. Table 2 shows the 2007 sample results compared to previous LANL results at the same locations. A plot of $^{236}U/^{238}U$ vs. $^{235}U/^{238}U$ is shown in Figure 1. A plot of $^{234}U/^{238}U$ vs. $^{235}U/^{238}U$ is shown in Figure 2. Plots of sample data within the envelope of natural, depleted and enriched compositions are shown in Figure 3. Table 3 shows calculated fractions of depleted, enriched and natural uranium for this set of sample analyses, while Table 4 shows the 2007 sample calculated fractions compared to previous LANL results at the same locations.

Table 1. New Thermal Ionization Mass Spectrometry Uranium Results

Sample ID	U (ng per g)	(+/-) (%)	238/235	(+/-) (%)	234/238 (e-6)	(+/-) (%)	236/238 (e-6)	(+/-) (%)
GS03	3.71	0.4	149.3	0.3	63.5	0.5	11.9	1
GS10	10.1	0.4	149.5	0.4	62.7	0.5	16.0	0.8
80205	79.2	0.3	137.9	0.3	76.6	0.5	BDL	
10594	103	0.4	139.8	0.3	71.0	0.5	1.5	2
SPP DISC	62.0	0.4	115.8	0.3	84.5	1.0	44.0	1
99405	439	0.4	138.1	0.4	74.8	0.5	BDL	
2547	9.99	0.4	148.0	0.4	63.0	0.5	16.1	0.7

Table 2. Comparison of Current with Previous Results

Sample ID	U (ng per g)	(+/-) (%)	238/235	(+/-) (%)	234/238 (e-6)	(+/-) (%)	236/238 (e-6)	(+/-) (%)
GS03 -02	2.2	5	153	5	62	25	9	8
GS03 -07	3.71	0.4	149.3	0.3	63.5	0.5	11.9	1.0
GS10 -02	9.4	4	153	5	61	25	11	8
GS10 -05	13.2	0.2	157.2	0.1	57.5	0.2	18.6	0.2
GS10 -07	10.1	0.4	149.5	0.4	62.7	0.5	16.0	0.8
2547	9.99	0.4	148.0	0.4	63.0	0.5	16.1	0.7
SPP DISC -02	41	5	128	5	78	25	24	8
SPP DISC-07	62.0	0.4	115.8	0.3	84.5	1.0	44.0	1.0
10594	108	5	142	5	78	25	BDL	
10594	128	5	139	5	84	25	BDL	
10594	132	5	140	5	88	25	BDL	
10594	123	5	137	5	80	25	BDL	
10594	103	0.4	139.8	0.3	71.0	0.5	1.5	2.0
99405 -05	396	0.2	138.0	0.1	74.8	0.2	BDL	
99405 -07	439	0.4	138.1	0.4	74.8	0.5	BDL	

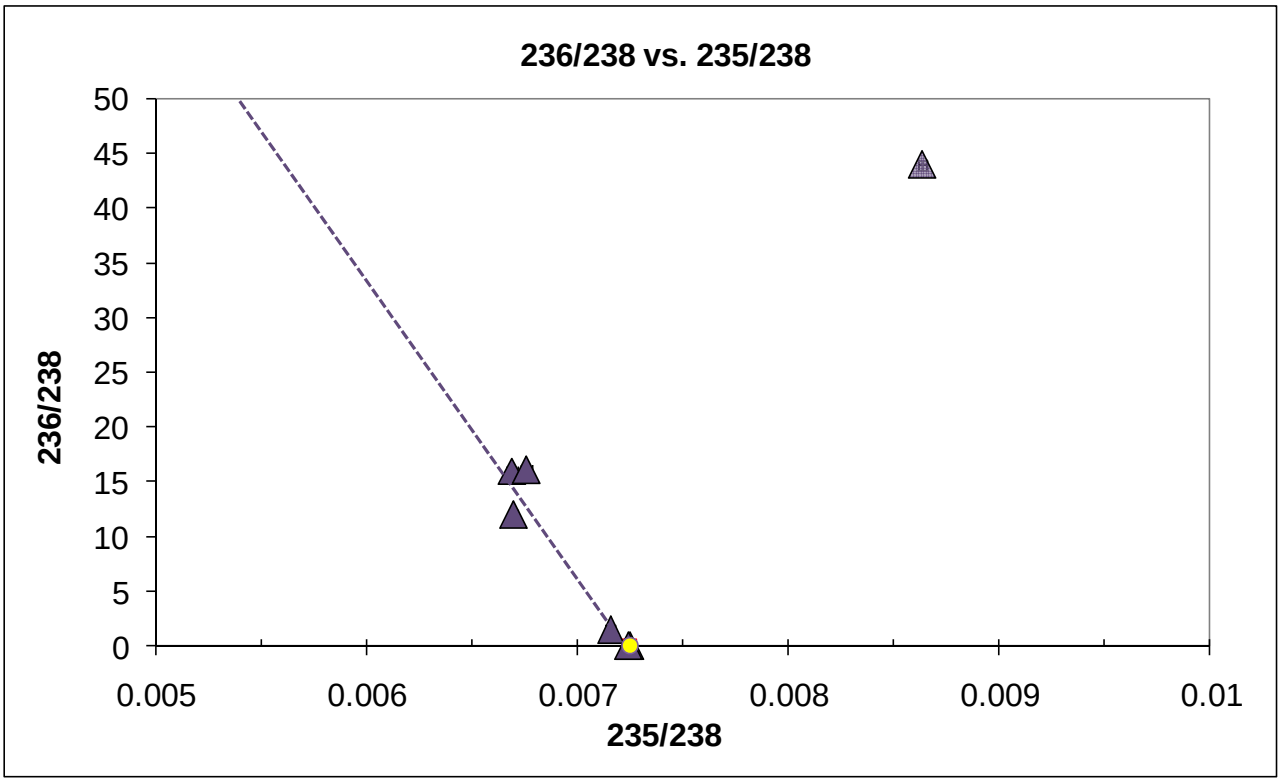


Figure 1. Thermal ionization mass spectrometry uranium results for 2007 RFETS waters. The blue dotted line is a two component mixing line between natural uranium and depleted uranium. These samples generally indicate natural U or the addition of 0-30% of a depleted U component and 0.0-0.1% enriched U component. In contrast, the SPP Discharge location indicates the presence of the addition of about 57% depleted U component and 0.43% of an enriched U component.

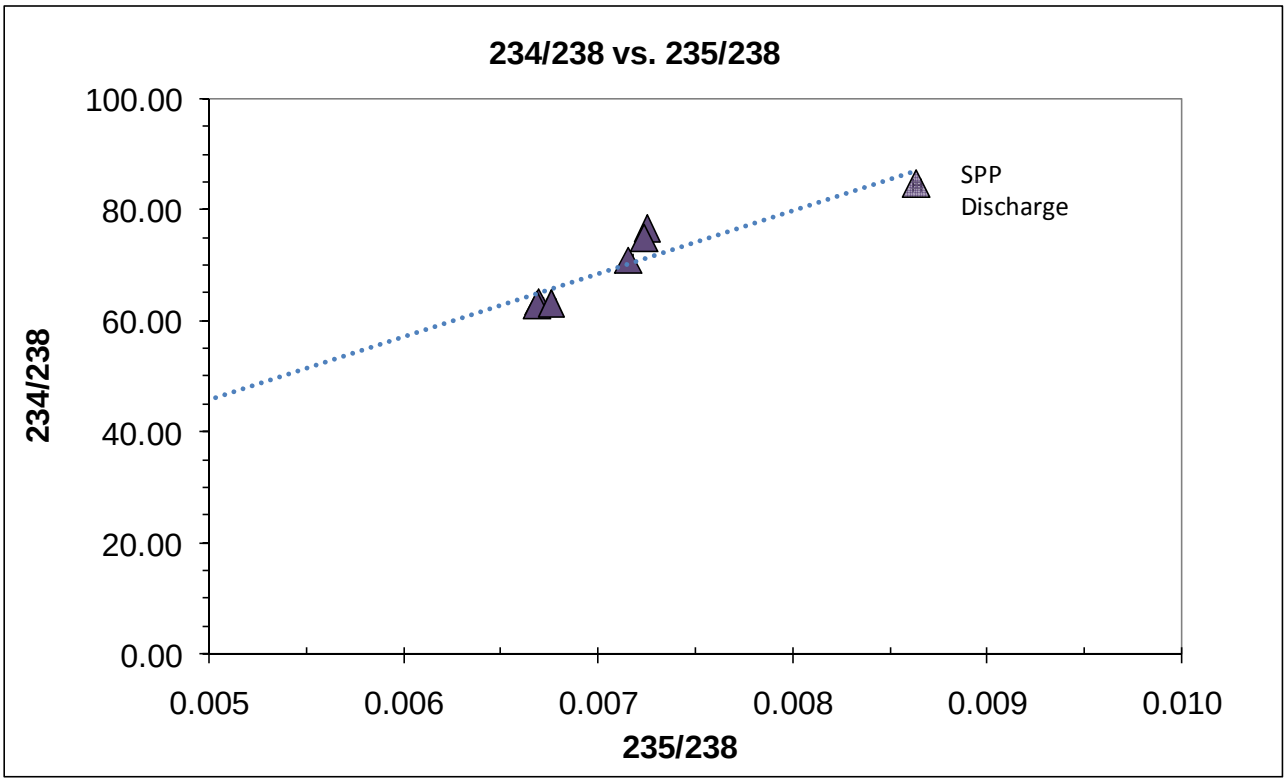
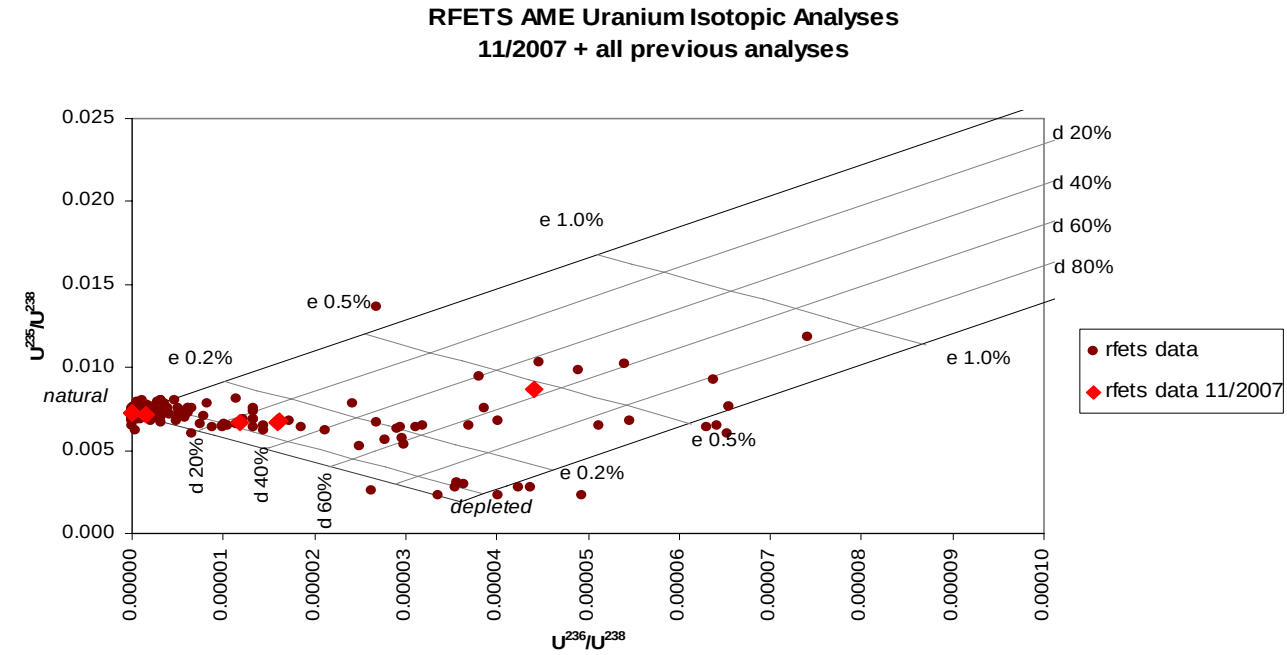


Figure 2. Thermal ionization mass spectrometry uranium results for RFETS waters. The $^{234}U/^{238}U$ results can be used to indicate flow paths and indentify end members.



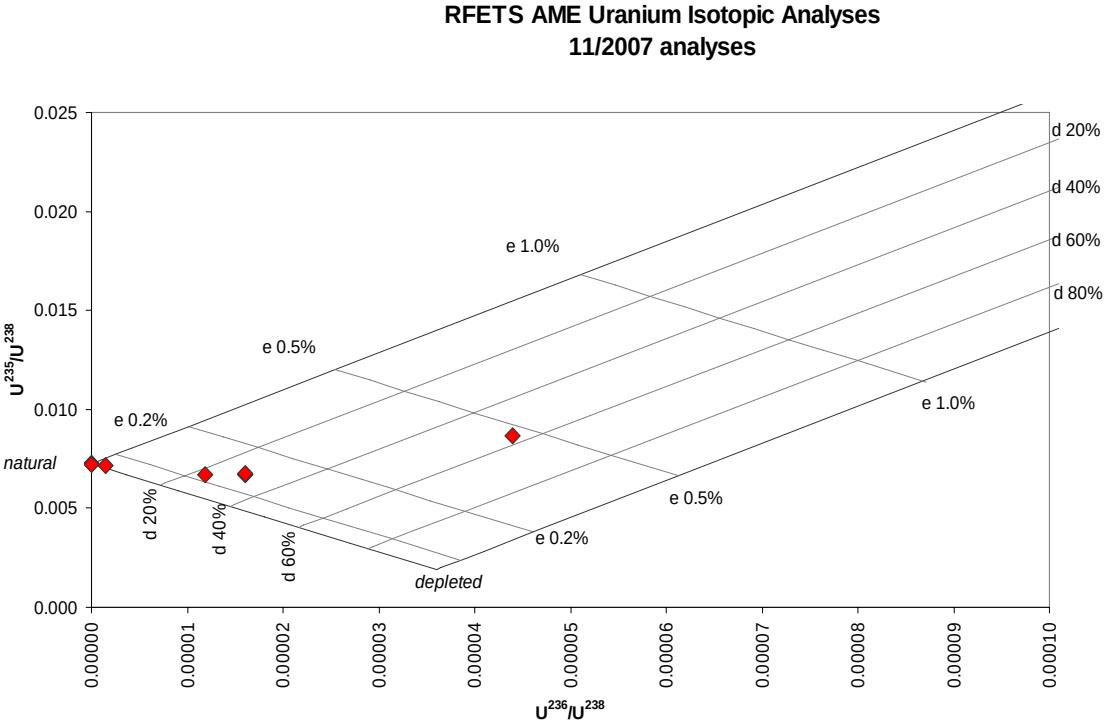


Figure 3. Isotopic results relative to calculated mixing between natural, depleted and enriched Uranium. Upper diagram shows new data from this report, with all previously measured samples. Lower diagram shows only the new sample analyses.

Table 3. Current Calculated Fractions of Depleted, Enriched and Natural Uranium Components

Sample	Location	Easting	Northing	Sample Date	depleted	enriched	natural
GS03	GS03	2093618.4	753645.5	7/9/2007	23.0%	0.07%	76.9%
GS10	GS10	2086741.3	750328.6	7/23/2007	29.4%	0.10%	70.5%
80205	80205	2082324.4	747535.6	9/7/2007	0.0%	0.00%	100.0%
10594	10594	2086746.4	752124.3	9/11/2007	3.1%	0.01%	96.8%
SPP Discharge gallery	SPP Discharge gallery	2085350.1	751764.4	9/12/2007	56.7%	0.43%	42.9%
99405	99405	2085584.8	749862.7	9/12/2007	0.1%	0.00%	99.9%
2547	GS10	2086741.3	750328.6	10/1/2007	29.0%	0.10%	70.9%

Table 4. Comparison of Current with Previous Results

Sample	Location	Easting	Northing	Sample Date	depleted	enriched	natural
80205	80205	2,082,324.4	747,535.6	9/7/2007	0.0%	0.00%	100.0%
15-239	SPP Disc	2,085,339.4	751,751.4	6/18/2002	32.6%	0.23%	67.2%
SPP Disc	SPP Disc	2,085,350.1	751,764.4	9/12/2007	56.7%	0.43%	42.9%
99405	99405	2,085,584.8	749,862.7	8/8/2005	0.1%	0.00%	99.9%
99405	99405	2,085,584.8	749,862.7	9/12/2007	0.1%	0.00%	99.9%
514-005	GS10	2,086,741.0	750,326.0	5/1/2002	22.1%	0.04%	77.8%
GS10	GS10	2,086,741.0	750,326.0	8/11/2005	36.2%	0.10%	63.7%
GS10	GS10	2,086,741.3	750,328.6	7/23/2007	29.4%	0.10%	70.5%
2547	GS10	2,086,741.3	750,328.6	10/1/2007	29.0%	0.10%	70.9%
16-24	10594	2,086,746.5	752,124.3	6/22/1999	1.9%	0.00%	98.1%
21-87	10594	2,086,746.5	752,124.3	12/7/1999	0.3%	0.00%	99.7%
7-120	10594	2,086,746.5	752,124.3	2/7/2000	0.0%	0.00%	100.0%
15-191	10594	2,086,746.5	752,124.3	6/8/2000	0.3%	0.01%	99.6%
10594	10594	2,086,746.4	752,124.3	9/11/2007	3.1%	0.01%	96.8%
514-002	GS03	2,093,622.1	753,639.9	5/1/2002	21.5%	0.04%	78.5%
GS03	GS03	2,093,618.4	753,645.5	7/9/2007	23.0%	0.07%	76.9%

Discussion

In comparing calculated fraction results, the greatest change is in the SPP Discharge Gallery. The fractions of depleted and enriched U components have increased by a factor of approximately 1.7-1.9 (Table 4), while the total concentration of U has increased by a factor of 1.5 (Table 2). This could indicate that the flow of water with natural U is decreased and/or that the contaminated source is drying out, both of which would increase the proportions of contaminant U component.

Sample 80205 is in the area of the original landfill, where samples with both natural U component and relatively contaminated samples have previously been analyzed.